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THE GENITAL PAPILLAE OF THREE SPECIES OF SCORPIONS (SCORPIONES: CHACTIDAE): A SEM STUDY (***)

INTRODUCTION – Sexual dimorphism in scorpions is represented by numerous secondary sexual characteristics among which the genital papillae or crochets that are placed in the categories "presence of a feature in one sex but not in the other", is a character unique to males in most taxa (POLIS & SISSOM, 1990).

These paired structures are placed underneath the medial edges of each genital operculum of the coxosternal region, protruding from their posterior margin (SISSOM *et al.*, 1990).

In *Buthus occitanus* (AMOREUX, 1789) and *Mesobuthus gibbosus* (BRULLÉ, 1832), the genital papillae may be easily identified, just visible to the naked eye, because of their lenght, 0.5 mm approximately, and are found, to all appearance, only in mature males; in *Scorpio maurus fuscus* (HEMPRICH & EHRENBERG, 1829), these structures may be recognized in subadult males too, raising the genital opercula.

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A pair of genital papillae protruding from the posterior margin of the genital opercula are also found in all mature males, examined under this aspect, of three species of Chactidae, genus *Euscorpius* Thorell, 1876 during a thorough research on the sex ratio of these scorpions in the Mediterranean area.

A scanning electron microscopy (SEM) study of these structures has been carried out to evaluate and to compare morphological patterns of the genital papillae among *Euscorpius* species.

METHODS – Adult specimens (scorpions of greatest size) of *Euscorpius* recently collected (in the field) in Latium, Central Italy, and preserved in ethanol 75° in the zoological collection of the Società Romana di Scienze Naturali, SRSN (Rome) were firstly examined in diffuse light at up to 20-30 times magnification (Fig. 1). Differential diagnosis of species was made possible using tricobothrial patterns, particularly the V serie of the chela manus ventral surface: the following three species were recognized (V = 3, V = 4, V = 7 or more, respectively (VACHON, 1983)):

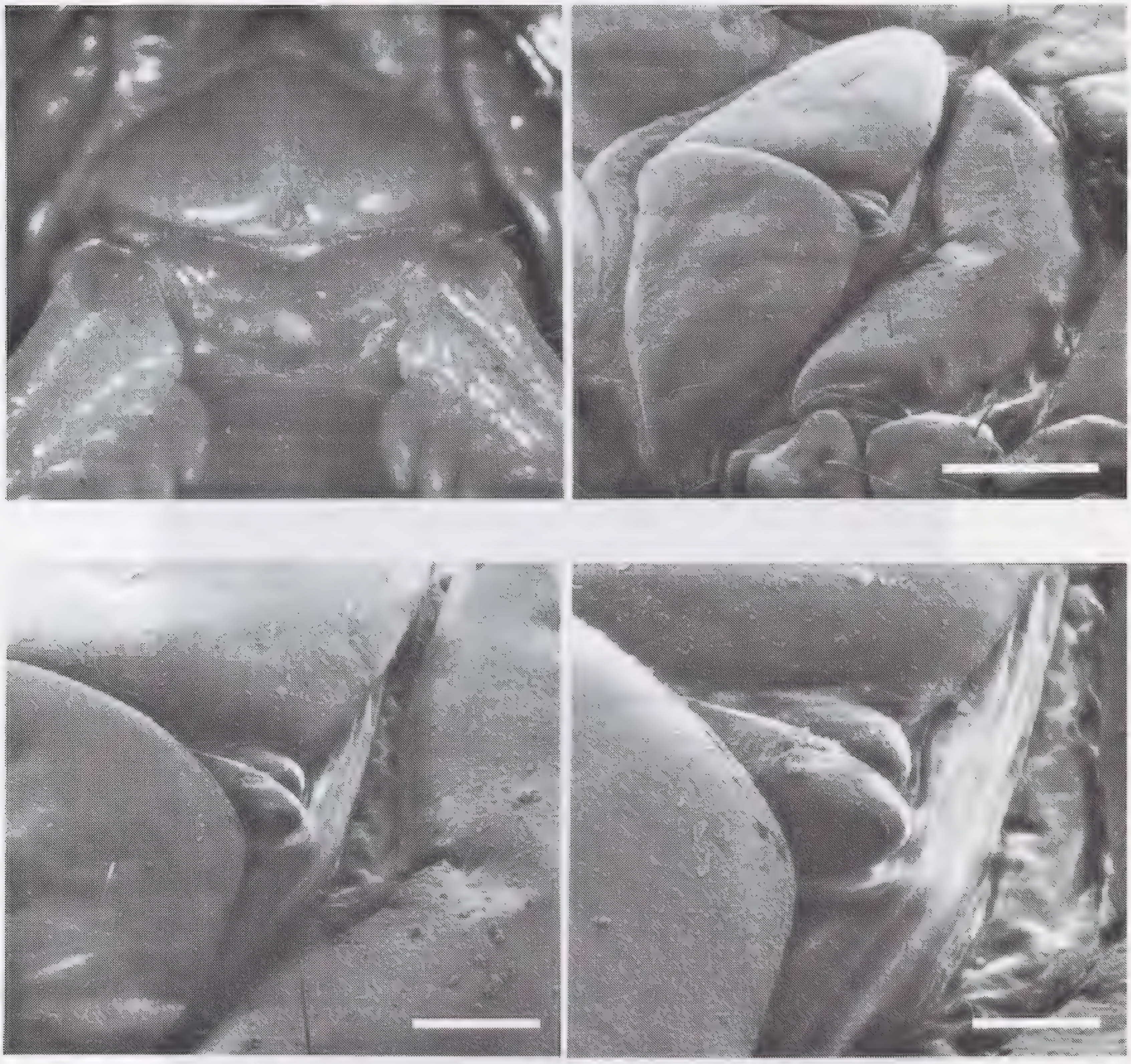
Euscorpius carpathicus (LINNAEUS, 1763);
Euscorpius flavicaudis (DE GEER, 1778);
Euscorpius italicus (HERBST, 1800).

The coxosternal area including the genital papillae of each specimen of *E. carpathicus*, *E. italicus* and *E. flavicaudis* were put, without fixing, into an ascending ethanol-aceton series. Samples were sputter-coated with gold, using the Balzers SCD sputter coater and observed on a Stereoscan 240 scanning electron microscope (Cambridge, UK) at 15 Kv.

SEM-photos of prolateral views of the coxosternal area of *E. flavicaudis* at three different magnifications were taken (Figs. 2-4). SEM-photos of the same area, frontal view, of each species, at two different magnifications were taken (Figs. 5-10).

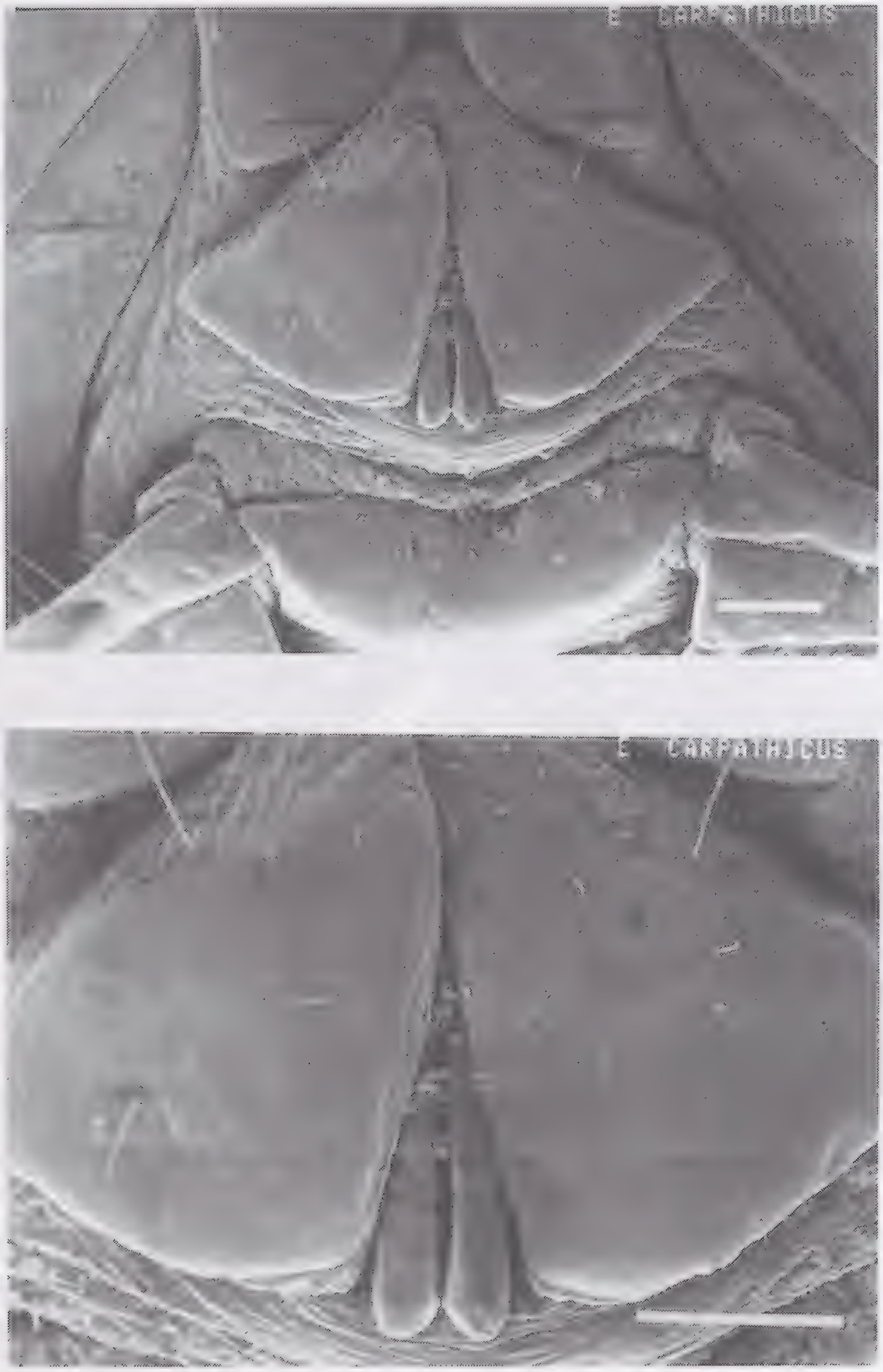
Morphological terminologies are according to STAHNKE (1970) and HJELLE (1990).

RESULTS – The genital opercula of *E. flavicaudis* are roughly triangular; their lateral margins are rounded and slightly raised in the middle; along the posterior margin, in the centre, a pair of genital papillae (GP) are easily visible, protruding from the genital fissure, over the postgenital fold (Figs. 2-4).



Figs. 1-4 - *Euscorpius flavicaudis* (De Geer), ♂; (1) diffuse light photo of the coxosternal region at up to 25 magnification approximately; (2) SEM-photo of the same area, prolateral view, bar = 500 µm; (3) SEM-photo of the area including the genital papillae (centre), prolateral view, at larger magnification, bar = 200 µm; (4) SEM-photo of the same area, prolateral view, at larger magnification, bar = 100 µm.

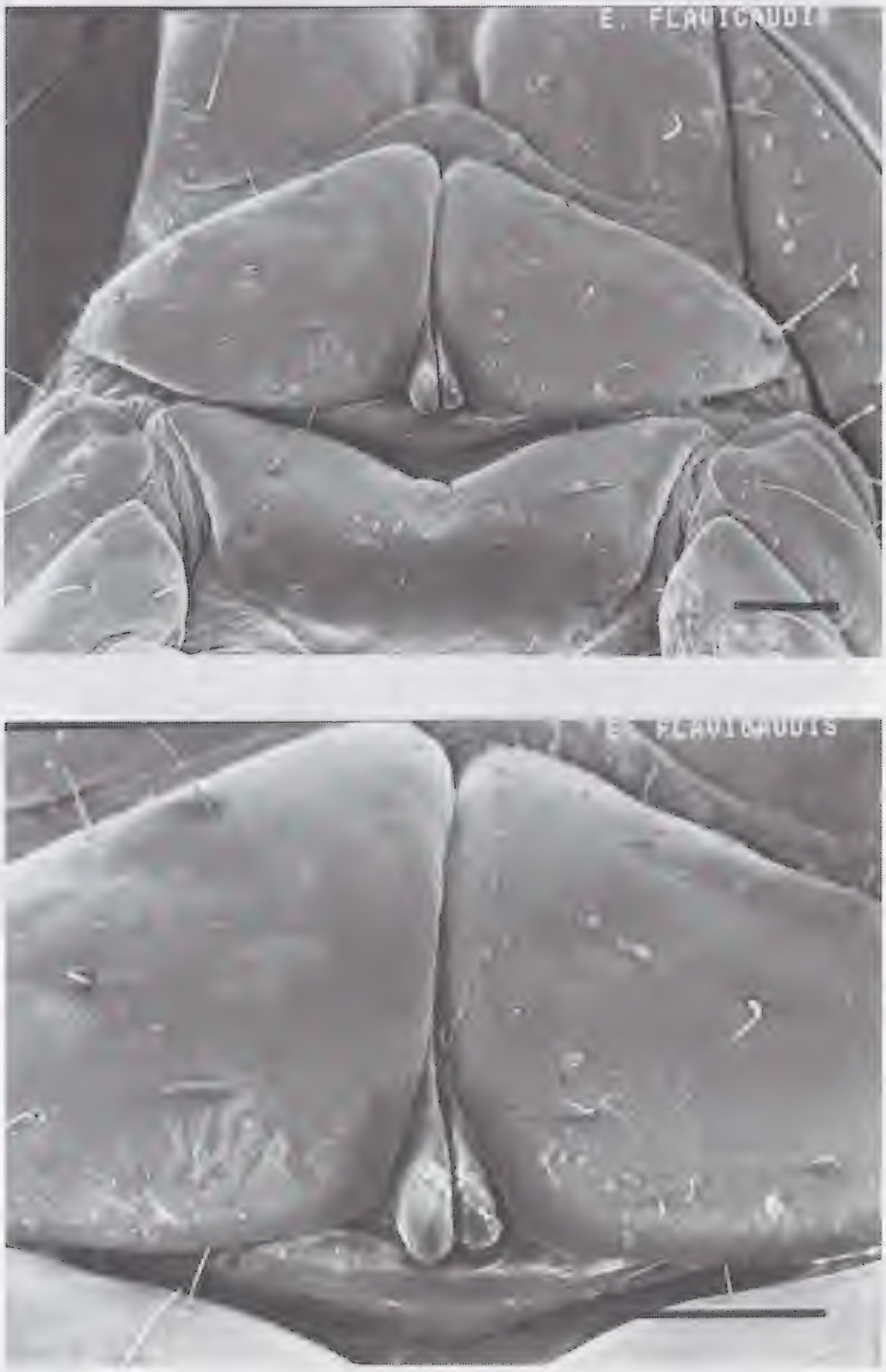
Each of the genital opercula (GO) of *E. carpathicus* resembles an equilateral triangle; they are in contact for no more than one third of the lenght of the genital fissure along its front share; in the medial and hind share, the GO are separated by a pair of GP extending beyond the posterior margin of the opercula with their rounded tips which jut out for one fifth of their lenght over the postgenital fold. The GP of *E. carpathicus* resemble a bat-like form, 0.30 mm in lenght, approximately (Figs. 5-6).



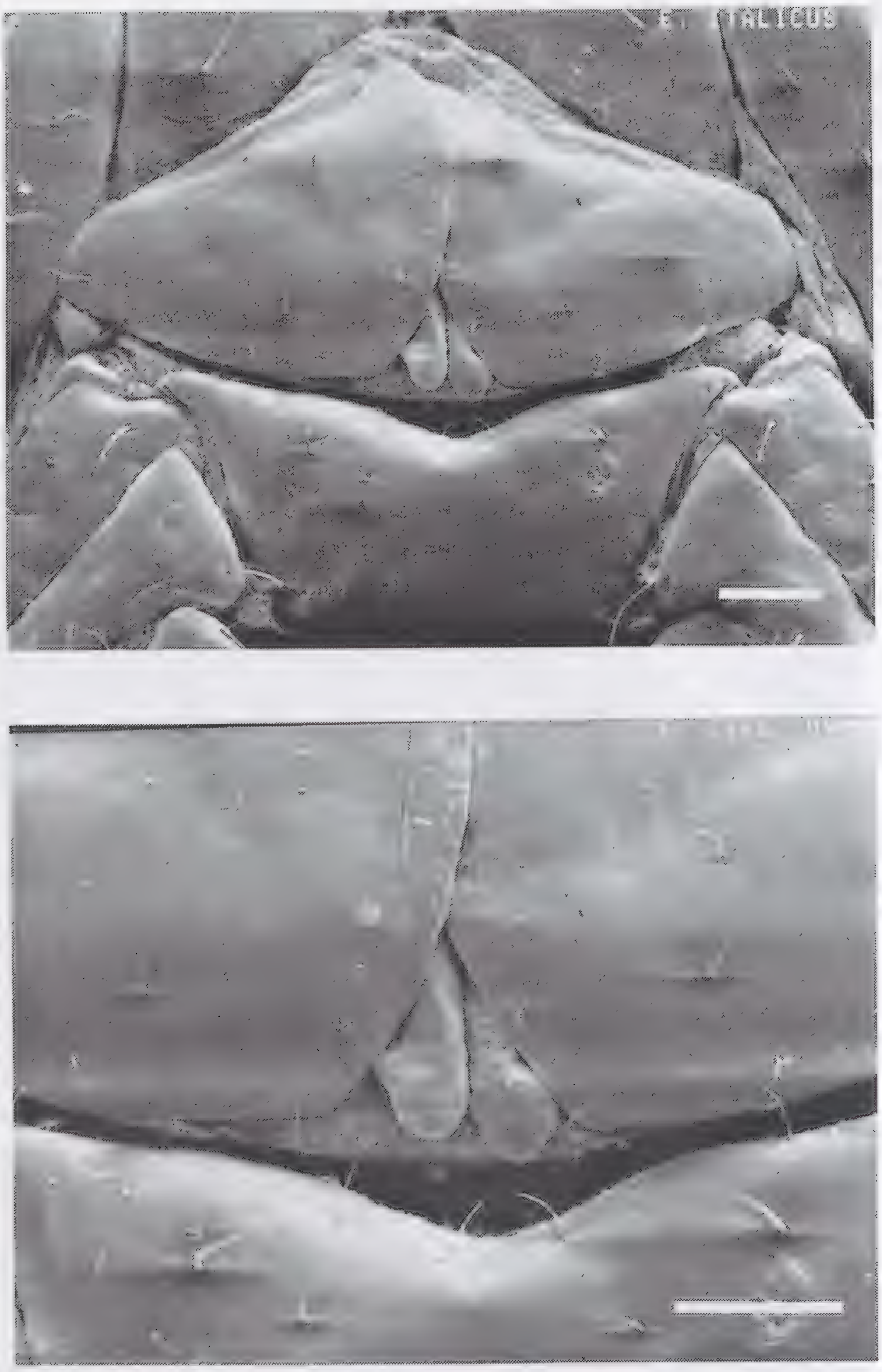
Figs. 5-6 - *Euscorpius carpathicus* (LINNAEUS), ♂, SEM-photos: (5) the coxosternal region including the genital papillae (centre), the genital opercula, the postgenital fold and the basal plate; (6) larger magnification of the genital papillae and the genital opercula. Bar = 250 μm.

The GO of *E. flavicaudis* resemble a flared right-angled triangle; their upper and lateral margins are rounded; they are in contact for more than two thirds of the total lenght of the genital fissure. In the last one third, the GO are separated by the GP protruding beyond the posterior margin of the opercula: the rounded tips jut out for approximately one third of their lenght over the postgenital fold. The GP of *E. flavicaudis* resemble a short club-like form, 0.25 mm in lenght, approximately (Figs. 7-8).

The GO of *E. italicus* resemble that of *E. flavicaudis*; the medial and posterior margins are quite rounded; the lateral margin of the right operculum (left in ventral view, v.v.) covers three fourths of the left operculum (right in v.v.). The GP jut out, with their rounded tips, the postgenital fold. Like *E. flavicaudis*, the anterior margin of the basal piece has a sag in the middle. The GP of *E. italicus* resemble a short club-like form, 0.30 mm in lenght, approximately (Figs. 9-10).



Figs. 7-8 - *Euscorpius flavicaudis* (De Geer), ♂, SEM-photos: (7) the coxosternal region including the genital papillae (centre), the genital opercula, the postgenital fold and the basal plate; (8) larger magnification of the genital papillae and the genital opercula. Bar = 250 μm.



Figs. 9-10 - *Euscorpius italicus* (Herbst), ♂, SEM-photos: (9) the coxosternal region including the genital papillae (centre), the genital opercula, the postgenital fold and the basal plate; (10) larger magnification of the genital papillae and the genital opercula. Bar = 250 μm.

DISCUSSION – The study of some external structure of Chactidae of the genus *Euscorpius* as seen by the scanning electron microscope, was found of a certain taxonomic importance untill the work of the late Italian arachnologist Antonio VALLE who first described the peg sensilla of *E. carpathicus* and *E. germanus* (Valle, 1975). This study has pointed out the fine morphology of the genital papillae and some other related structures of the coxosternal region: the main differences in size and shape among the three species examined may be summarized as follows:

- the GO of *E. carpathicus* are curled up, while the GO of *E. flavicaudis* and *E. italicus* are elongated;
- the GP of *E. carpathicus* are tapered at the base and broadened at the tip which is quite rounded; they are large (in comparison with the GO size) and symmetrical; the GP of *E. flavicaudis* and *E. italicus*, on the other hand, look alike and are quite flattened; their tips are perfectly rounded and less large (in comparison with the GO size); apparently, they are asymmetrical but this may be due to the condition of the specimen fixed in ethanol;
- contrary to *E. carpathicus*, the anterior margin of the basal piece of *E. flavicaudis* and *E. italicus* has an evident sag in the middle.

SEM analysis does not suggest anything about the ontogeny of the genital papillae, an interesting problem that would greatly benefit from future studies as other aspects of scorpion embriology largely neglected in recent times (POLIS & SISSOM, 1990).

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RIASSUNTO

Attraverso la miscroscopia elettronica a scansione è stato condotto uno studio sulla morfologia delle papille genitali di tre specie di scorpioni (genere *Euscorpius*) provenienti dal Lazio (Italia centrale). Vengono discusse le principali differenze morfologiche.

ABSTRACT

A scanning electron microscopy study of the genital papillae of three species of scorpions (genus *Euscorpius*) of Latium, Central Italy, has been carried out. The main morphological patterns are discussed.

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